CONSEIL GÉNÉRAL DE L'ÉCONOMIE
DE L'INDUSTRIE, DE L'ÉNERGIE ET DES TECHNOLOGIES

OECD
BETTER POLICIES FOR BETTER LIVES

Assessing the Economic Impact of Nanotechnology: an OECD Perspective

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SNO Conference

Santa Barbara (CA), 3 November 2013

Sustainable Nanotechnology Organization
Research | Education | Responsibility

the Inter-Governmental Organisation for Economic Cooperation and Development : **OECD**

The origin of the OECD dates back to 1960, when 18 European countries plus the United States and Canada joined forces to create an organisation dedicated to global development.

Today, the 34 OECD member countries span the globe, and include advanced and emerging countries.

OECD also has advisory committees from Business and Industry (BIAC) and Trade Unions (TUAC)

OECD – Global Partners

The OECD also works closely with emerging giants like China, India and Brazil and developing economies in Africa, Asia, Latin America and the Caribbean

The OECD's focus has broadened and it now maintains **co-operative relations with more than 70 non-member economies.**

The OECD had **regional initiatives** covering Europe, the Caucasus and Central Asia; Asia; Latin America; the Middle East and North Africa (MENA). The Sahel and West Africa Club creates, promotes and facilitates links between OECD countries and West Africa.

The OECD also **works with International Organizations** including -

International Labour Organization, Food and Agriculture Organization, International Monetary Fund, World Bank, International Atomic Energy Agency, and many other United Nations bodies, the International Transport Forum.

Summary of the Presentation

Introduction : **Stakes and Outcomes of the NNI-OECD Symposium**

1. **Setting the Nano-Economics Scene** at Global Scale
   - Indicators and methodologies
   - The Innovation Eco-System for Nanotechnology, a Platform Technology
   - Specific Issues from the Nanotechnology Roadmap towards Converging Technologies

2. **Sustainable Nanotechnology and LCA of manufactured goods** : the OECD case of the Tyres industry

3. **Pathway for Economic Impact : Stakeholders Initiatives**
   - From experimental Indicators to a full set of homogeneous Economic Data
   - Back to fundamentals : a universal description system for the nanoscale
   - A Sustainability Assessment Impact (SIA) mechanism for opening up the markets

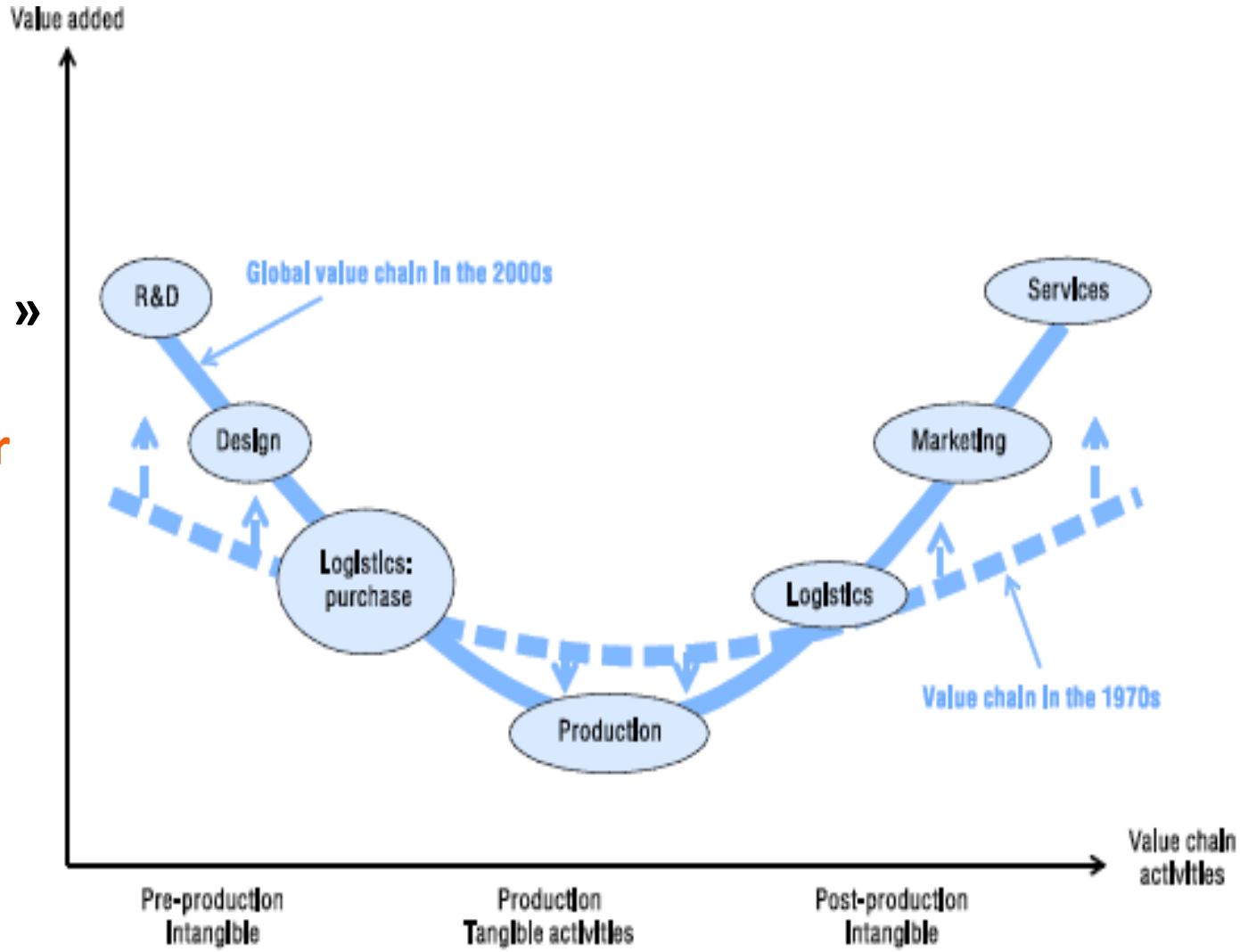
Conclusion : **Two priorities for action at the international level**

Introduction

OECD : towards New Approaches of Economic Challenges

The Systemic Economic Crisis and the « Smiling Curve » 1970s – 2010s

Where will your next Business Opportunities stand?



Source: Based on Shih (1992), Dedrick and Kraemer (1999), and Baldwin (2012).

The objectives of the OECD –NNI Symposium on Assessing the Economic Impact of Nanotechnology

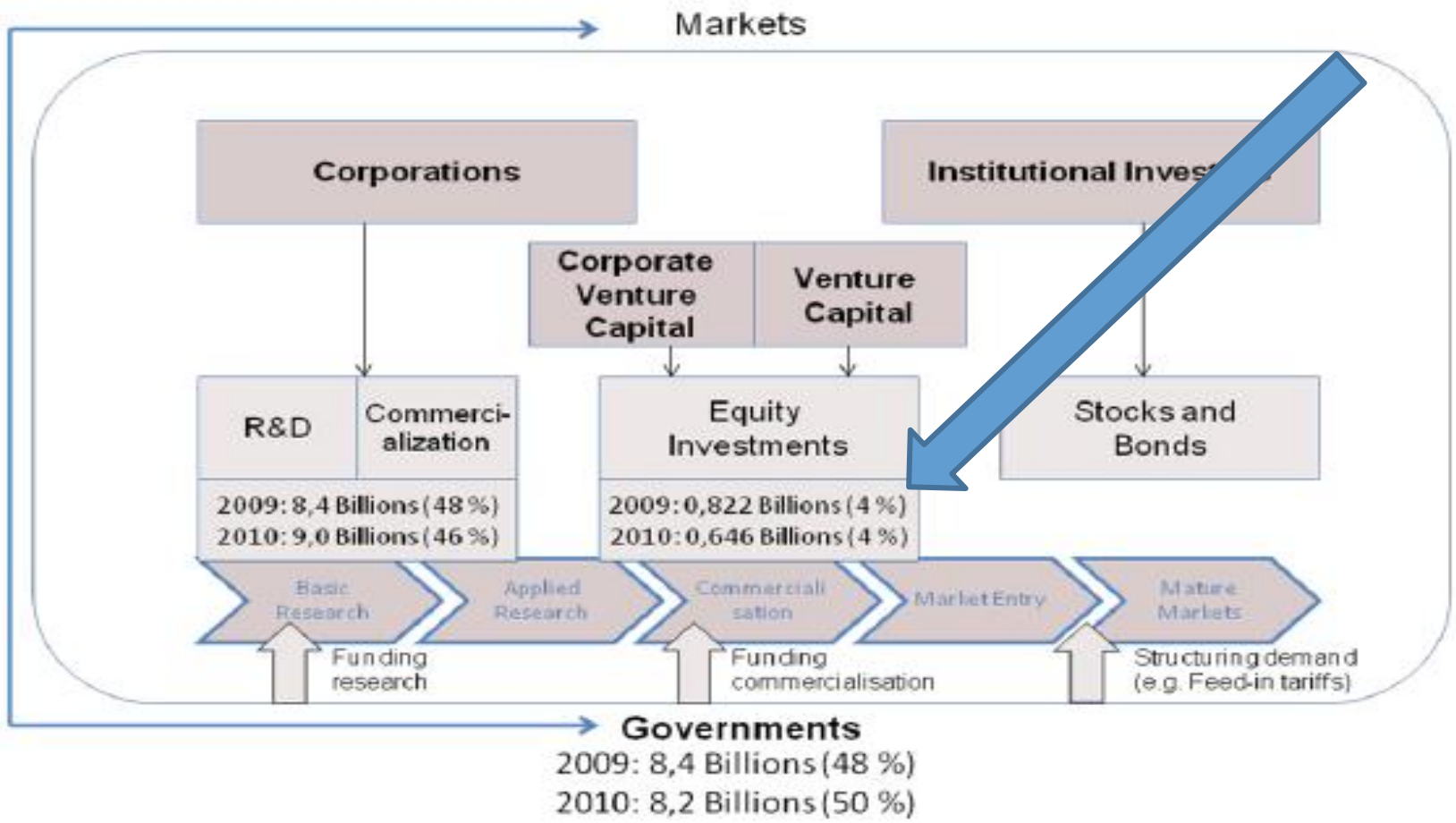
- Since its creation in 2007, **the OECD WP on Nanotehnology had proposed to address the economic, legal and societal frameworks of Nanosciences and Nanotechnologies in order to provide Governments the right guidance towards a Responsible, Sustainable Development.**

- **The 27th and 28th of February 2012, a symposium hosted by AAAS in Washington DC, « systematically explored the need for, and development of methodology <u>to assess the economic impact of nanotechnology across whole economies</u>** »

  - **Many sectors and types of impact;**
  - **New and replacement products and materials;**
  - **Markets for raw material, intermediate and final goods;**
  - **Employment and other economic impacts**

How much Private Stakeholders are ready to spend in Nanotechnology ? *Comparatively Weak Venture Capital*.

Figure 1: Private Funding of Nanotechnology. Investment figures in US$, source: Lux Research (2011)



1. Setting the Nano-Economics Scene at Global Scale

a) Indicators and methodologies

Input indicators (and the global Value-Chain)

- *R&D public and private funding*
- *Investments at large*

Output indicators and the nanotechnology-induced changes

- *Knowledge creation, publications and patents*
- *Advances in Science and technology*
- *Production and Commerce*

Impact indicators for an informed decision making

- Jobs, meeting grand social and environmental challenges
- Framework indicators (on public opinion…)

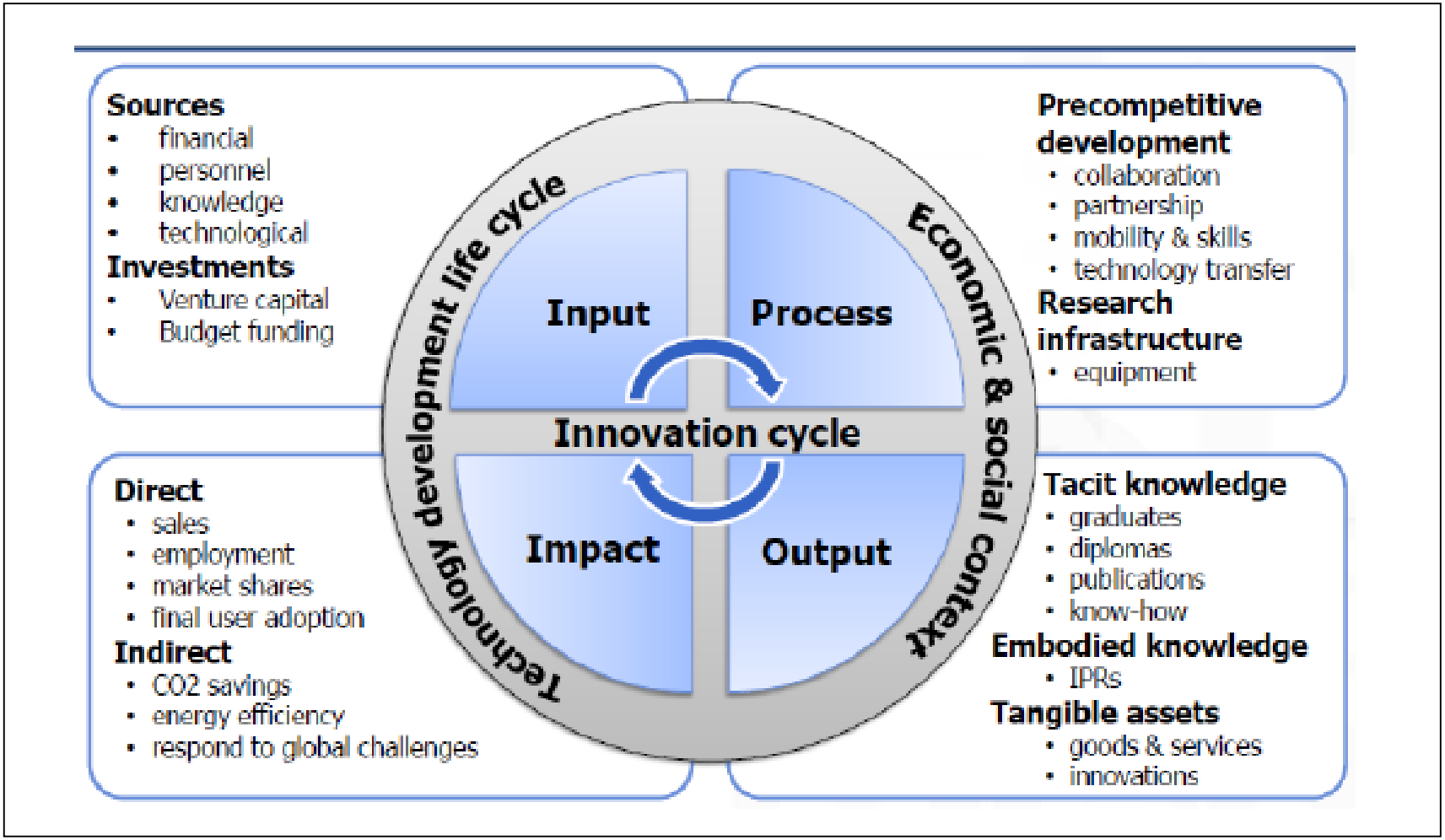
b) The innovation eco-system : towards a new paradigm

- Nanotechnology as a **key enabling, platform technology**
- **Open innovation** : the difference between be or not to be for Business

c) Specific issues related to the nanotechnology roadmap towards Converging Technologies at the nanoscale

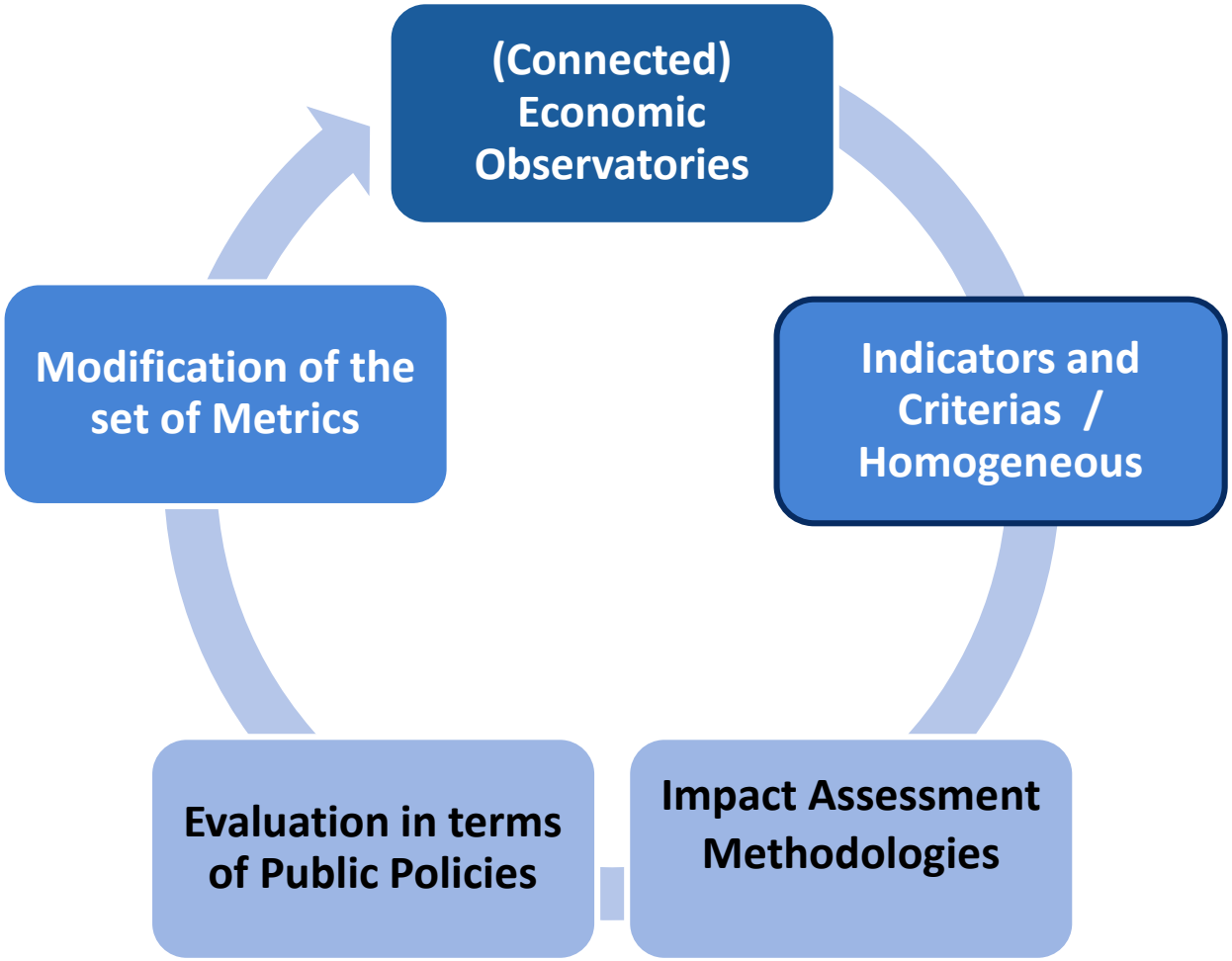
- **The IPR issue** in a brave new world of convergence at the nanoscale
- *Can you measure, integrate, guaranty, insure it* ? Nanometrology contribution to the added-value of nanomanufacturing.

Indicator System (*qualitative and quantitative*) for Measuring Nanotechnology Economic Impact.



Nanotechnology Governance Continuum :

How can Economic Knowledge can help Bridging the Gaps



OECD Proposed Key Nanotechnology Indicators (KNI) 2013 *rely on robust definitions, not yet available*

- **NANOTECHNOLOGY FIRMS**
  - KNI 1 Number of nanotechnology firms (production and/or R&D firms)
  - KNI 2 Percentage of nanotechnology firms with fewer than 50 employees (production and/or R&D firms)

- **2. NANOTECHNOLOGY R&D IN THE ENTERPRISE SECTOR**
  - •KNI 3 Nanotechnology R&D expenditures in the business sector
  - •KNI 4 Nanotechnology R&D intensity in the business sector
  - •KNI 5 Percentage of nanotechnology R&D expenditure by dedicated nanotechnology R&D firms in the services sector
  - •KNI 6 Percentage of nanotechnology R&D expenditure performed by small nanotechnology R&D firms

- **3. NANOTECHNOLOGY R&D IN THE PUBLIC SECTOR (GOVERNMENT + HIGHER EDUCATION SECTOR)**
  - KNI 7 Intramural nanotechnology R&D expenditures in the public sector
  - KNI 8: Nanotechnology R&D expenditures in the public sector as a percentage of total R&D expenditure in the public sector
  - Possibility to look at firms by application – to be explored

- **4. NANOTECHNOLOGY PATENTS (from existing OECD data)**
  - KNI 10 Share of countries in nanotechnology patents filed under PCT (*calculated by OECD Secretariat using* OECD Patent Database)
  - KNI 11 Revealed technological advantage in nanotechnology (*calculated by OECD Secretariat using* OECD Patent Database)

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Addressing the limits : Availability of DATA (2013)

Nanotech data availability

Australia	No	Korea	Yes
Austria	No	Luxembourg	No
Belgium	Yes	Mexico	Yes
Canada	Yes*	Netherlands	No
Chile	No	New Zealand	No
Czech Republic	Yes	Norway	Yes
Denmark	Yes	Poland	Yes*
Estonia	No	Portugal	Yes
Finland	No	Russian Federation	Yes
France	Yes	Slovak Republic	Yes
Germany	Yes*	Slovenia	Yes
Greece	No	South Africa	Yes
Hungary	No	Spain	No
Iceland	No	Sweden	No
Ireland	Yes	Switzerland	Yes
Israel	No	Turkey	No
Italy	Yes	United Kingdom	No
Japan	Yes	United States	Yes*

OECD Indicators for Nanotechnology online.

But *Very Few Economic Indicators available*.

1. Nanotechnology firms
KNI 1 Number of firms active in nanotechnology, 2011 or latest available year
KNI 2 Percentage of small nanotechnology firms, 2011 or latest available year

2. Nanotechnology R&D
KNI 3 Nanotechnology R&D expenditures in the business sector, 2011 or latest available year
KNI 4 Nanotechnology R&D intensity in the business sector, 2011 or latest available year
KNI 5 Percentage of nanotechnology R&D expenditure by dedicated nanotechnology R&D firms in the services sectors, 2011 or latest available year
KNI 6 Percentage of nanotechnology R&D expenditure performed by small nanotechnology R&D firms, 2011 or latest available year

3. Public-sector nanotechnology R&D
KNI 7 Intramural nanotechnology R&D expenditures in the government and higher education sectors, millions of USD PPP, 2011 or latest available year
KNI 8 Intramural nanotechnology R&D expenditures in the government and higher education sectors as a percentage of total government and higher education sectors R&D expenditures, 2011 or latest available year

4. Nanotechnology patents
KNI 9 Share of countries in nanotechnology patents filed under PCT, 2008-10
KNI 10 Revealed technological advantage in nanotechnologies, 1998-2000 and 2008-10

Nanotechnology statistics: Methodology 2013 (xls)

STI Scoreboard 2013 indicators on nanotechnology

NEW: Oct.2013.

http://www.oecd.org/sti/nanotechnology-indicators.htm

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Nanotechnology Impact Assessment, Amplifiers and Multipliers

INVOLVING ECONOMISTS !

Understanding Industrial Uptake, Open Innovation, Demand side…

Micro

- **Global Industrial Forum on nanotechnology-induced changes**
- ***Potential role of OECD***

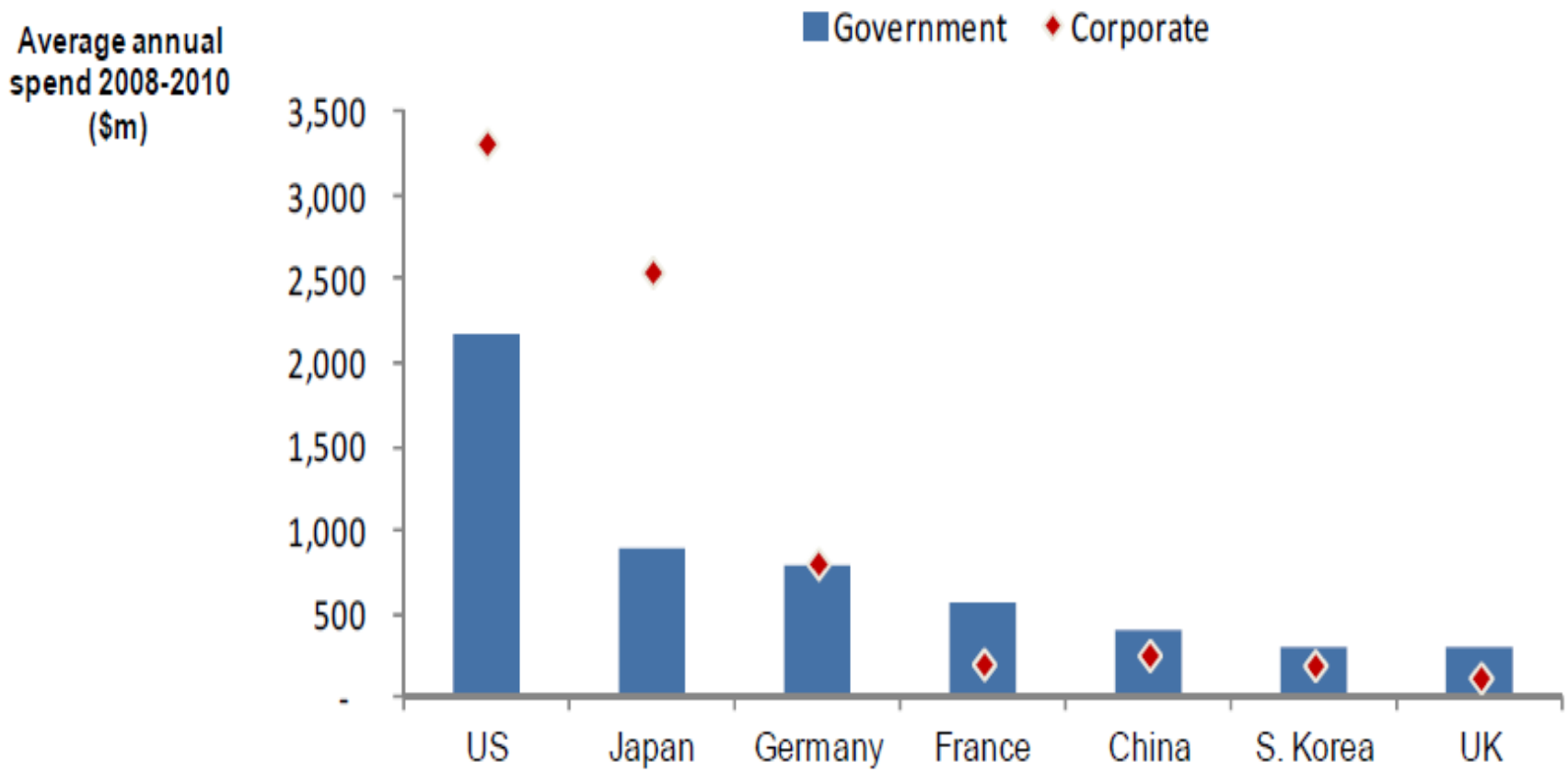
Meso

- CONVERGENCE
- **Understanding Multipliers**
- Value Chains

Macro

- Productivity
- Contribution to Growth
- Contribution to Jobs
- Contribution to Quality of Life

Assessing Public/Private Spending in Nanotechnology : Elements of International Benchmark



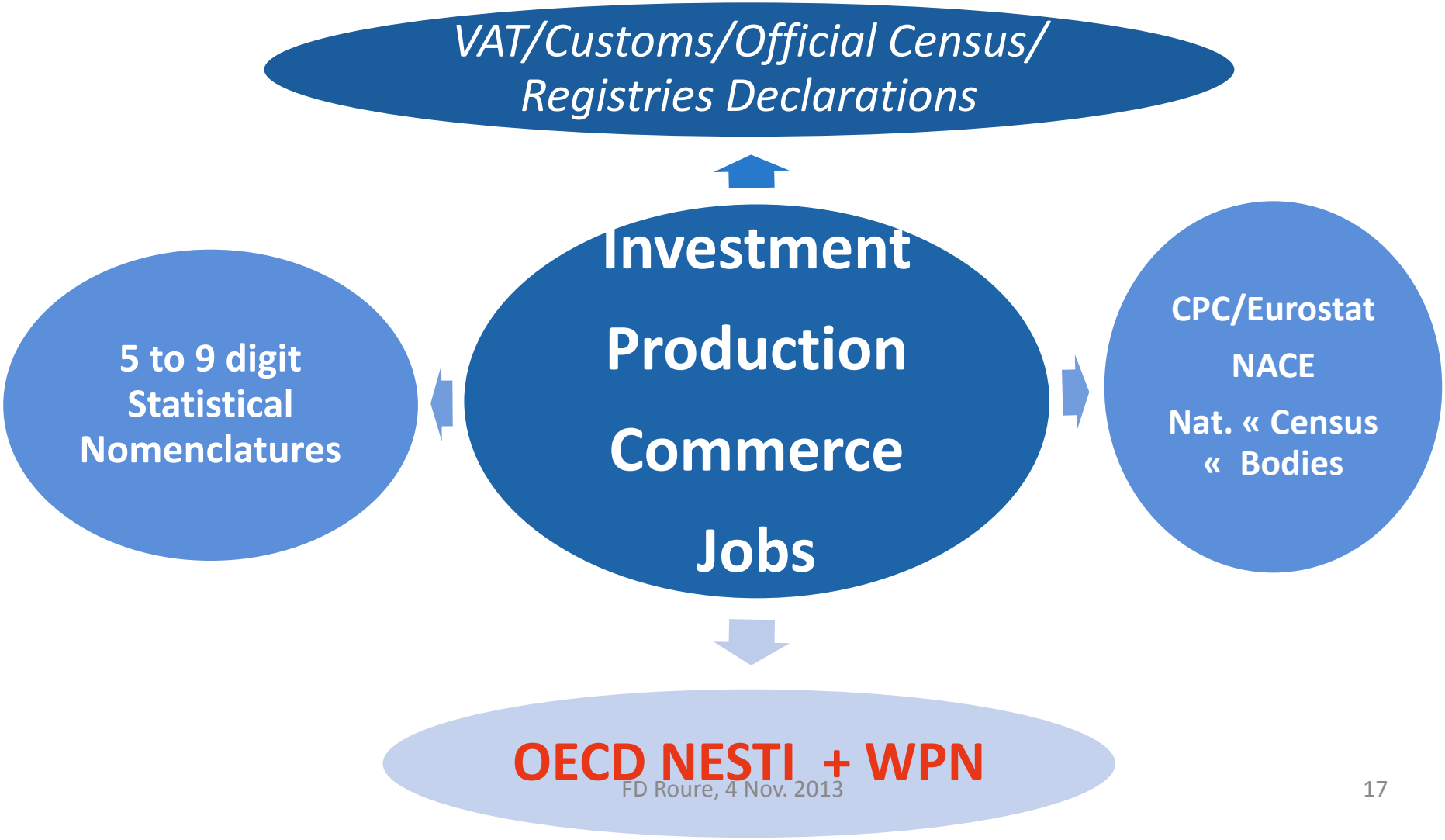
Source: PCAST, 2012

Accountability for Public Spending in Nanotechnology towards a Responsible R&D Scheme.

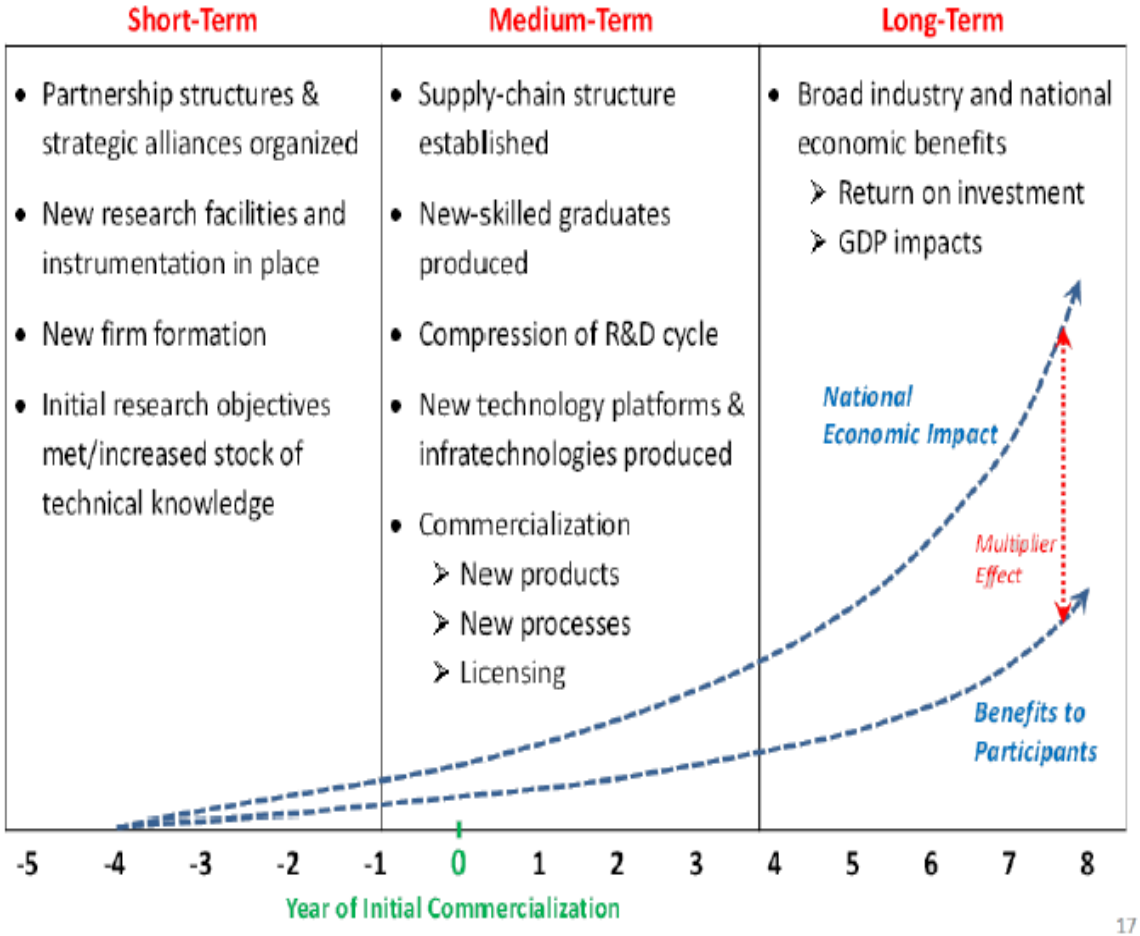
Country	Funding programmes	Nano-specific?	Period	Value
Brazil	Ministry for Science & Technology	no	Annual estimate	R$11.87 million [21] (€4.9 million)
China	Medium & Long Term Development Plan	yes	2006-2008	US$38.2 million [22] (€29.1 million)
European Union	Framework Programme 7	no	2007-2013	€3.5 billion[23]
France	Nano 2012 Programme	yes	2008-2012	€500 million[24]
Germany	Nano Initiative – Action Plan 2010	yes	2008-2013	€370 million[25]
India	Nano Mission	yes	2007-2012	Rs. 1000 crore[26] (€144.8 million)
Japan	MEXT	no	Annual estimate	€470 million[27]
Russia	Development of nanotechnology infrastructure in the Russian Federation for 2008 - 2011	yes	2008-2011	€693.3 million[28]
UK	Research Councils UK/Technology Strategy Board	no	Annual estimate	€256 million[29]
USA	National Nanotechnology Initiative	yes	2012	$2.1 billion[30] (€1.6 billion)

Source : OECD 2012

How delivering Counts and Statistics on real (direct) Nano-Economy ? *Adapting Statistical Nomenclatures is required to implement Economic Research, not only Surveys.*



Impact Metrics for a Nanotechnology Innovation cluster model. The Multiplier Effect.



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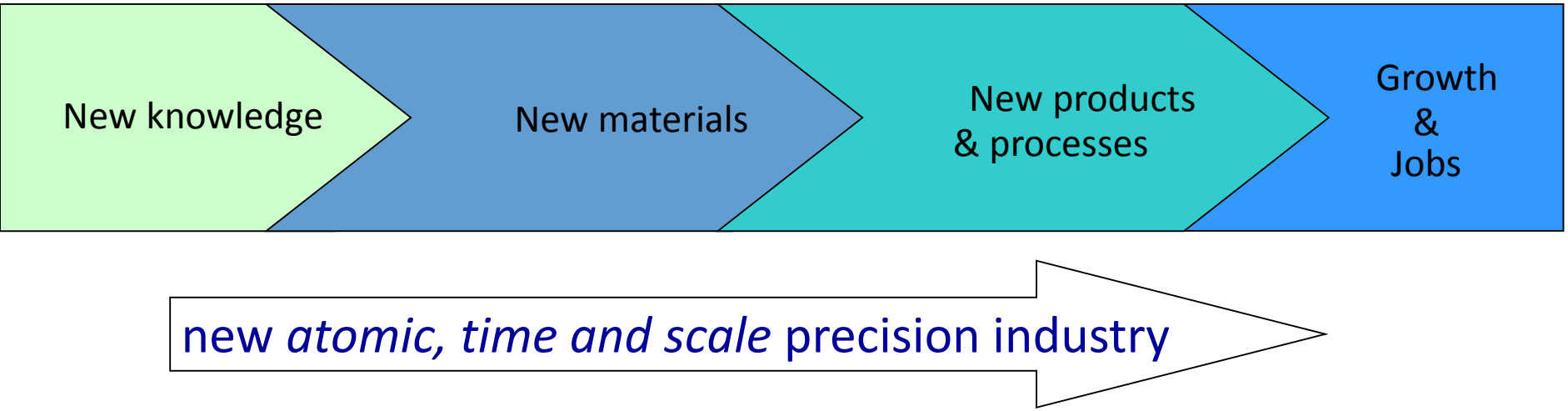
Source: OECD/NNI Symposium on Assessing the Economic Impact of Nanotechnology, 27-28 March 2012, Presentation by Gregory Tassey (Chief Economist, National Institutes of Standards and Technology, United States).

Nanomaterials are Advanced Materials Designed for purpose, with specific nanoscale properties

Materials are KNOWLEDGEmediaries
(intermediaries of knowledge) .

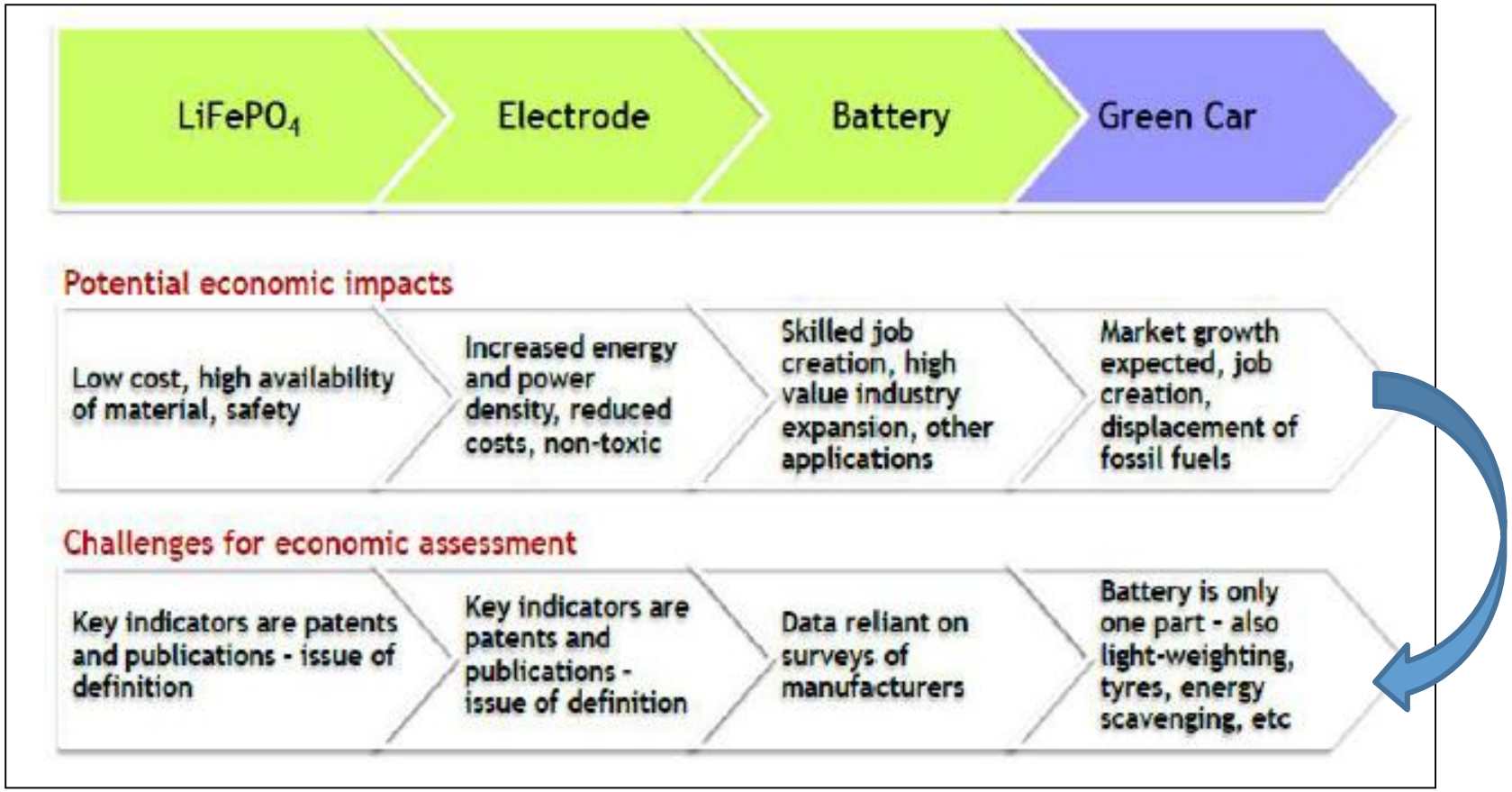
They contribute, with nano-systems, to the Multiplier Effect.

Materials embed and «transfer» the new knowledge
into new products and processes, therefore we hear of «(re)active»
or «**intelligent» materials, materials that «perform a work**»



Adapted from EU/Renzo Tomellini

Ex. of a Value Chain: *nano-battery in a green car*



Source: OECD/NNI Symposium on Assessing the Economic Impact of Nanotechnology, 27-28 March 2012, Presentation by Mark Morrison Chief Executive Officer, Institute for Nanotechnology, United Kingdom.

Challenges in evaluating Return on Investment in Nanotechnology and its Broader Economic Impact

- The OECD-NNI Symposium took stock of the **fact that there are no accepted definitions of nanotechnology products, processes and companies, yet they are essential for collecting data** *and comparing countries*.

- « **The fact that nanotechnology can have an impact along the value chain highlights the need for those collecting economic data to understand fully the impact of nanotechnology :**

  - **- at each stage of the value chain** *and across the multi-disciplinary/ /multi-application value chains that can arise from the enabling nature of nanotechnology,*
  - - **and its potential to contribute** to solutions for many global challenges »

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Global Investment for Leadership in Global Markets : Where does the Added-Value stand in NanoManufacturing

Estimated Value of ***Advanced Materials*** (VAM) H2050*(Unit : Billion €)*

Table 1: VAMs market share by sector

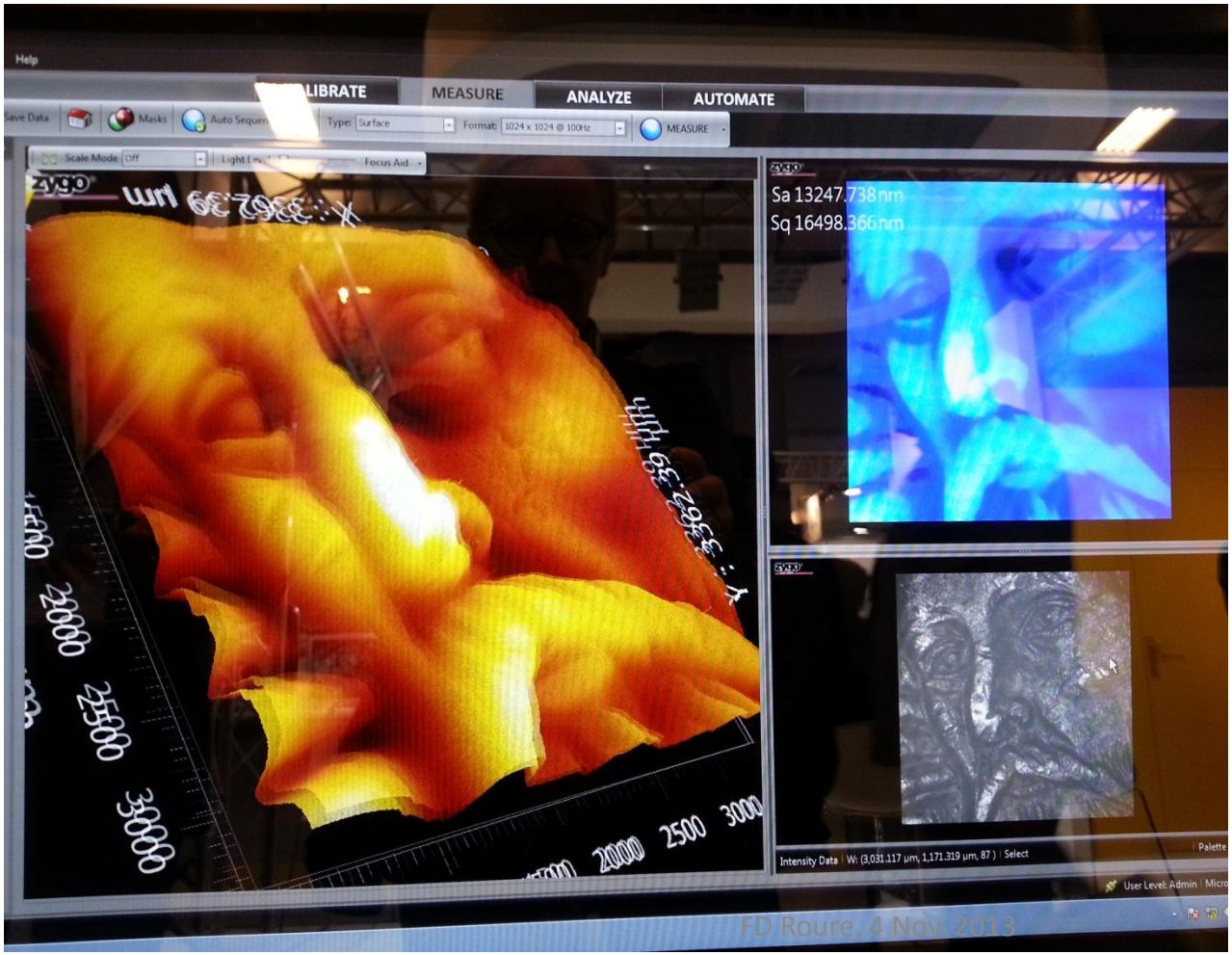
	2008	2015	2020	2030	2050
Energy	7,1	14,3	18,9	37,0	175,7
Transport	9,6	13,1	15,8	24,3	52,6
Environment	24,6	38,2	48,0	86,8	352,2
Health	27,0	32,1	37,4	55,0	115,2
ICT	29,6	38,8	46,6	70,7	152,2
Others / Cross-cutting	3,6	13,5	19,3	42,2	250,8
Total projected value of identified VAMs markets	**101,7**	**150,0**	**186,1**	**316,0**	**1098,6**

Source: Oxford Research AS. Unit: billion euro.

European Union H2020 R&D Program – Value Chain

VALUE CHAIN 1: Lightweight multifunctional materials and sustainable composites
1. Nano-enabled Multilayer barrier materials, Y1, Pilot lines up to TRL 7
2. Cost effective industrial scale technologies for synthesis and technologies for dispersion/exfoliation (extrusion), Y1, Open access pilot lines, up to TRL 6
3. Synthesis and functionalization of particles for functional nano-inks used in flexible and rigid electronics, Y1, Pilot lines up to TRL 7
4. Integration of novel nano materials into existing production and assembly lines, Y2, Pilot lines up to TRL 8
5. High performance nano composites, Y2, Pilot lines up to TRL 8
6. Analysis and process control of dispersion of nanofillers into polymers, Y2, Metrology R&D up to TRL6
7. Precise control of morphology in nanoporous materials, Y2, Metrology and process development up to TRL 6
8. Cost effective industrial scale synthesis and technologies for nanofibers, Y3, Pilot lines up to TRL 7

Quality Control of Surfaces at the nanoscale : an Added Value of Nano Systems.



Quality Control of a Coin's surface
(20 cents (€)

Source : **ZYGO**
Rugosité, Planéité

Symposium Outcome: Nanotechnology as a Platform Technology, and adapting IPR models for Innovation.

- **For Platform, Enabling Technologies like Converging Technologies, industrial challenges come from economies of scope** more than economies of scale to serve a heterogeneous set of submarkets with a generic production system .

- **Comparative Advantages come from the Management of the Whole Technology Life Cycle**

- The « **Missing Middle** » between TRL 4 to 7 is where investment is so crucial to capture added value (Tech. translation, Tech. transfer to manufacturing)

- **IPR must be protected indeeds, and adequatel…**
- **…BUT traditional IPR models will fail to provide innovation at the right pace.**

- **In Emerging Technologies, Innovation comes from:**
  - **Societal needs and expectations** more than from technology push;
  - **Agregation of existing Patents in affordable economic conditions**
  - **A stable and incitative legal and economic framewok**
  - **Compliance to Sustainability and Accountability on Corporate Societal Responsibility**

2. Sustainable Nanotechnology and LCA of manufactured good : *the OECD ongoing case of the Tyres industry* (2012-2014)

a) What's in, why choosing this industry? An OECD template.

- Intentionally manufactured nanomaterials : the list
- Economic impact of nano-enabled tyres

b) Sustainability, LCA and socio-economic responsibility

- Protecting occupational health in the nanomanufacturing of tyres
- Protecting the environment along the tyres whole life-cycle

c) The contribution of standards in tyre nanomanufacturing development and beyond

- Definitions, characterization and reproducible EHS tests for manufactured nanomaterials: voluntary contribution. ISO+OECD
- Adapting the industrial process to the societal and regulatory requirements: a pre-competitive issue.

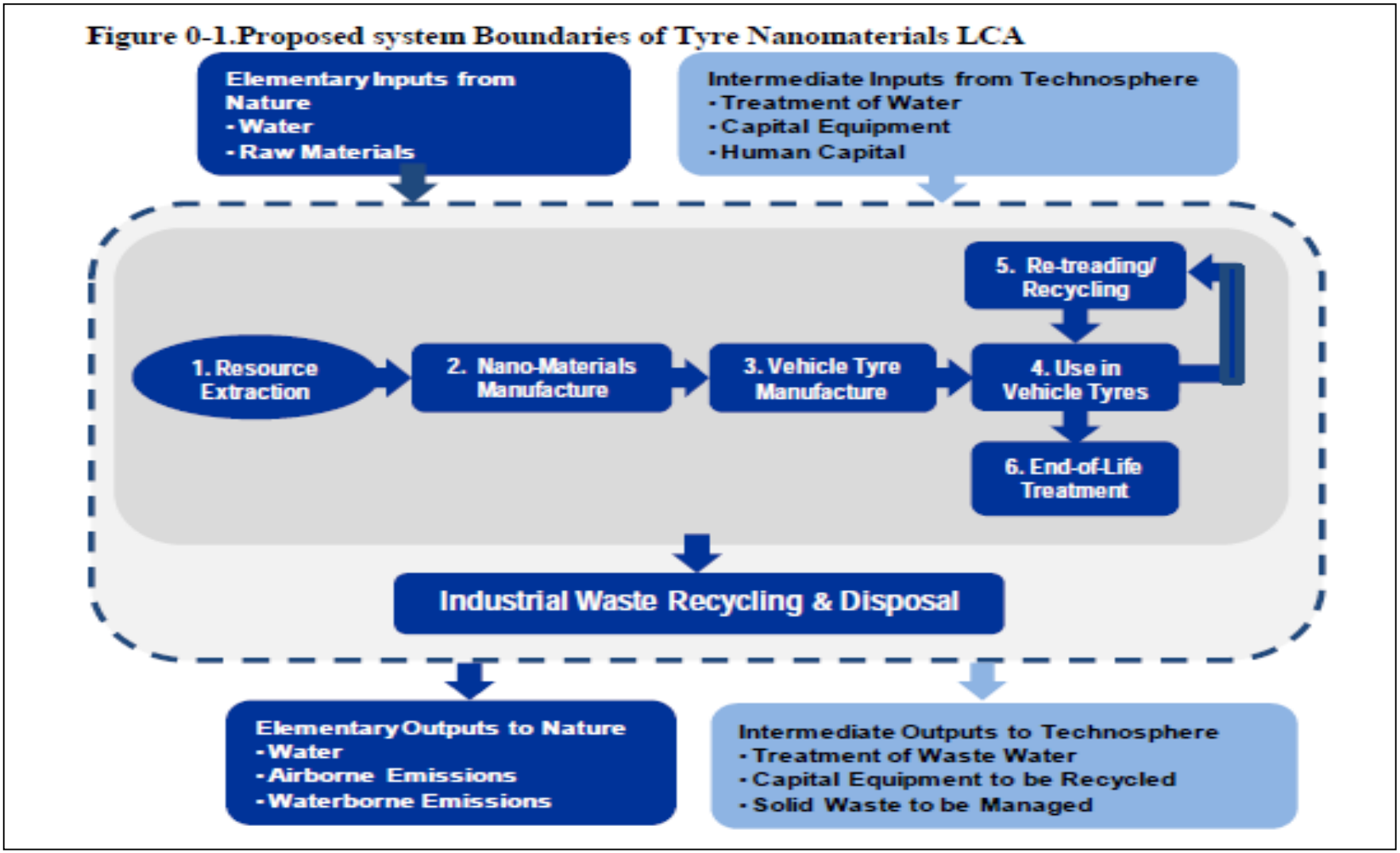
The WPN project on *Nanotechnology for Green Growth*

Project components

Tyres case study

- Joint project between WPMN and WPN, supported by the Tyre Industry Project of the World Business Council for Sustainable Development
- The case study will consider many issues arising from the use of nanotechnology and nanomaterials in the tyre industry *including*
  - Status of the technology
  - Societal impacts;
  - Positive & negative environmental impacts through LCA;
  - Environmental Health and Safety risks & best practices; and
  - Knowledge & best practice transfer

Sustainable development of Nanomaterials in Tyres an *ongoing* OECD Case Study



Tyres : What 's in It ?

Technology	Example trade names	Loading	Technology readiness	Application
Carbon black	Corax, Ecorax (Evonik) Vulcan (Cabot)	50-100 phr	Mature	Improve mechanical propert
Silica + Silane	Ultrasil (Degussa) Zeosil (Rhodia); Hi-Sil (PPG Industries)	30-80 phr	Mature	Lower rolling resistance with compromising performance traction, grip (especially on surfaces) and tread life
Montmorillonite Clay (MMT)	Dellite (Laviosa Chimica Mineraria S.p.A); Closite (Southern Clays) ; Bentonite AG/3 (Dal Cin S.p.A); Nanofil (Sud Chemie)	1-10phr	Market entry / Prototype	Decrease gas permeability, better trade-off between han and comfort, better thermop stability and reduced decay. Sealing inside of tyres; pote decreasing amount of rubbe making tyres lighter and coo running (lowering rolling resistance).
Core/shell Polymer nanoparticles:	NanoProTech: Core Composition 86% styrene / 14% divinylbenzene [4]	<20phr	Market entry	Improvement in cornering ar steering response; reduced generation. Weight reductio since the core-shell particles significantly less dense than carbon black or silica fillers.
Carbon Nanotubes (Multi-wall)	Baytubes (Bayer) Fibril (Hyperion Catalysis)	1-10phr	Basic research / Applied Research	Reduce rolling resistance th reduced heat generation. Im durability – possibly even pa life of the car itself. Improved tensile strength, tear strength and hard-ness of the composites, by almost 600%, 250% and 70% respectively compared to pure styrene-butadiene rubber

Technology	Example trade names	Loading	Technology readiness	Application	Developers
Graphene		0.1-5%	Basic research / Applied Research – tyre applications since 2008	The graphene can be produced at a much lower cost than can carbon nanotubes but offers similar characteristics to carbon nanotube composites. More durable tyres due to better heat dissipation.	Pirelli, Nanotek Instruments Inc. Princeton University
Polyhedral Oligomeric Silsesquioxanes (POSS)		3.5phr		Increase wet traction without sacrificing rolling resistance or abrasion resistance.	Kumho Tire; Goodyear; Bridgestone
Rubber nanoparticles	Nanoprene		Market entry	Improves dry road grip by between 10% and 15%. Significantly cuts wear	Lanxess, Rhein Chemie; Toyo Tire
Silica carbide	Purenano	5-30 phr		Improve wet grip and 50% reduction in abrasion	Nanoproducts Co; Cabot; Kumho; Michelin
A nanoclay containing BIMSM (brominated isobutylene-co-para-methylstyrene elastomer)		<10wt%	Market entry	Increased air retention properties. The resulting tyres are 20% more durable due to the improved inflation retention. Weight savings of up to 1 kg for large truck tires	ExxonMobil
Aerogels		1-20wt%	Basic research / Applied Research	Lighter, longer-lasting tyres	Kumho; Cabot; Goodyear ("silica gels") ; ExxonMobil
Nanodiamond		1-10wt%	Basic research / Applied Research	Improves rolling resistance while maintaining reinforcing properties, and to ensure excellent abrasion resistance, braking ability and fuel efficiency	Nissan; Hankook

Notes: phr = parts per hundred (rubber)

	Hankook, Nexen, Sumitomo, Lanxess, Goodyear

OECD Template for Sustainability of Nanotechnology in the Tyre Industry : *elements of methodology*

- ***Life Cycle Inventory (LCI):*** examines the sequence of steps in the life cycle boundaries of the product system, beginning with raw material extraction and continuing on through material production, product fabrication, use, and reuse or recycling where applicable, and final disposition. For each life cycle step, the inventory identifies and quantifies the material inputs, energy consumption, and environmental emissions (atmospheric emissions, waterborne wastes, and solid wastes). In other words, the LCI is the quantitative environmental profile of a product system. Substances from the LCI are organised into air, soil, and water emissions or solid waste.

- ***Life Cycle Impact Assessment (LCIA):*** characterises the results of the LCI into categories of environmental problems or damages based on the substance's relative strength of impact. Characterisation models are applied to convert masses of substances from the LCI results into common equivalents of one category indicator.

- ***Interpretation:*** uses the information from the LCI and LCIA to compare product systems, rank processes, and/or pinpoint areas (e.g. material components or processes) where changes would be most beneficial in terms of reduced environmental impacts. The information from this type of assessment is increasingly used as a decision-support tool.

Nano-enabled tyres will be evaluated relative to reference tyres (i.e. tyres that do not contain nano-materials) and the associated difference in life cycle impacts quantified for each life cycle phase: 1) nano-material production, 2) tyre production, 3) use, and 4) end-of-life.

The study will comply with the following voluntary international standards for LCAs:

- ISO 14040: 2006, Environmental management – Life cycle assessment – Principles and framework

- ISO 14044: 2006, Environmental management – Life cycle assessment – Requirements and guidelines

OECD Template Meeting SNO expectations? More initiatives welcomed from Industries which would wish to use it ! *PoW 2015-2016 in preparation now …*

Develop a Life-Cycle Assessment Appropriate for Green Nanoproducts. Before a product or production process can be considered green, the product's EHS implications must be assessed using an appropriately tailored life-cycle assessment (LCA) that is capable of identifying and quantifying nanotechnology EHS implications and gauging the trade-offs that arise in the context of their applications. An LCA is a comprehensive management tool that is used to evaluate how a material and/or a product, from the status of production through end-of-life, affects ecosystems and human health.

Source :

ACS Sustainable Chemistry & Engineering

Feature

pubs.acs.org/journal/ascecg

Sustainable Nanomaterials: Emerging Governance Systems

Lynn L. Bergeson*

Bergeson & Campbell, P.C., 2200 Pennsylvania Avenue NW Suite 100W, Washington, District of Columbia 20037

3. Pathway for Impact : Stakeholders initiatives.

a) From experimental indicators to a full set of homogeneous economic data

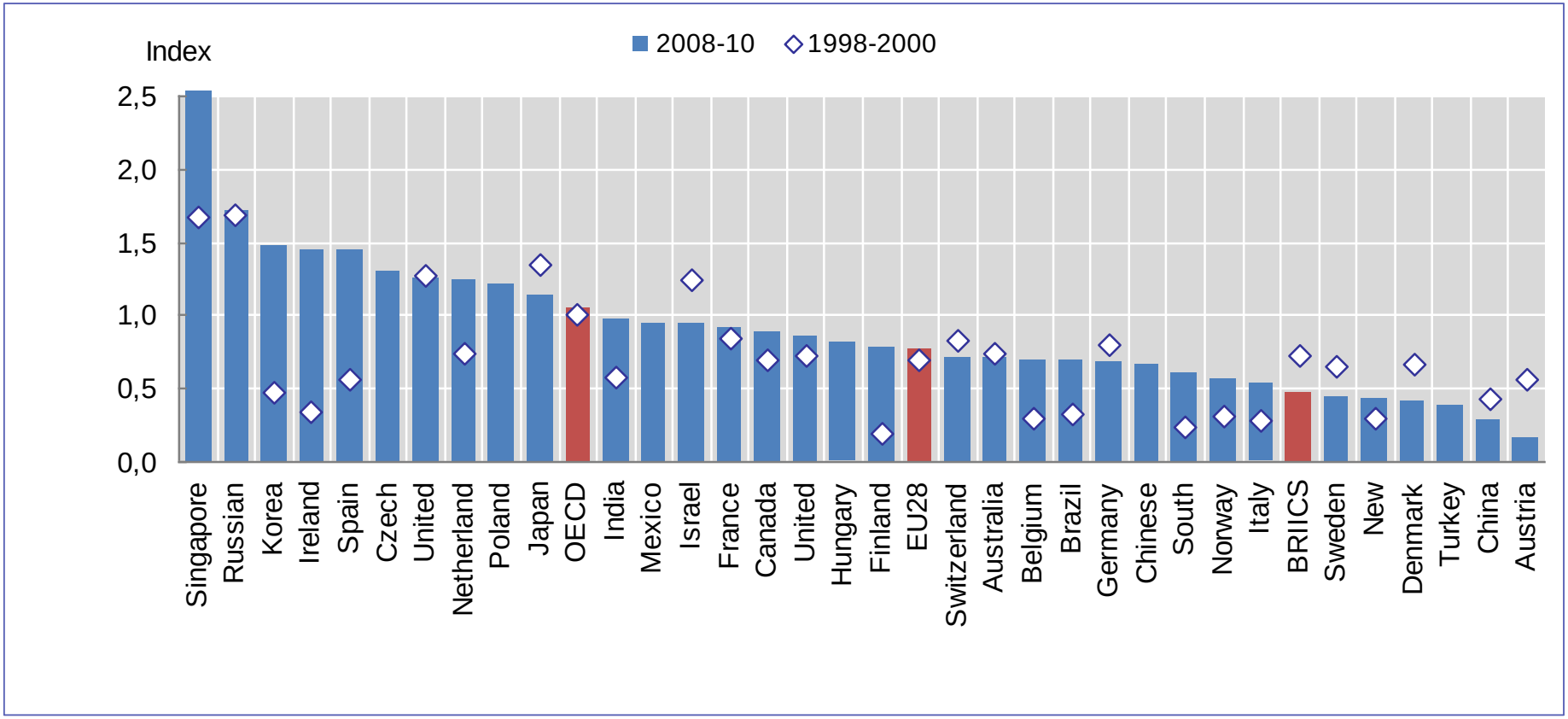
- Still under construction at OECD level but in progress *
- Qualitative indicators may help mapping out potential users requirements and avoid stranded investments
- A certain sense of urgency as regards accountability of public policies and spending in nanotechnologies (US GAO…)

b) Back to fundamentals: a universal description system to support responsible development of nanotechnology and its economic assessment is needed

- The "logic cascade" (from 3D representation to robust ontology supporting Information Systems)
- The traceability issue (citizens, consumers, public stakeholders requirements) and ISO TG2 CASD (consumers and societal dimension of standards) potential contribution

c) Opening up the nano- related markets with a Sustainability Impact Assessment (SIA)

Indicator of Revealed Comparative Advantage for Nanotechnology (*share of nano patents in the total of patents*)



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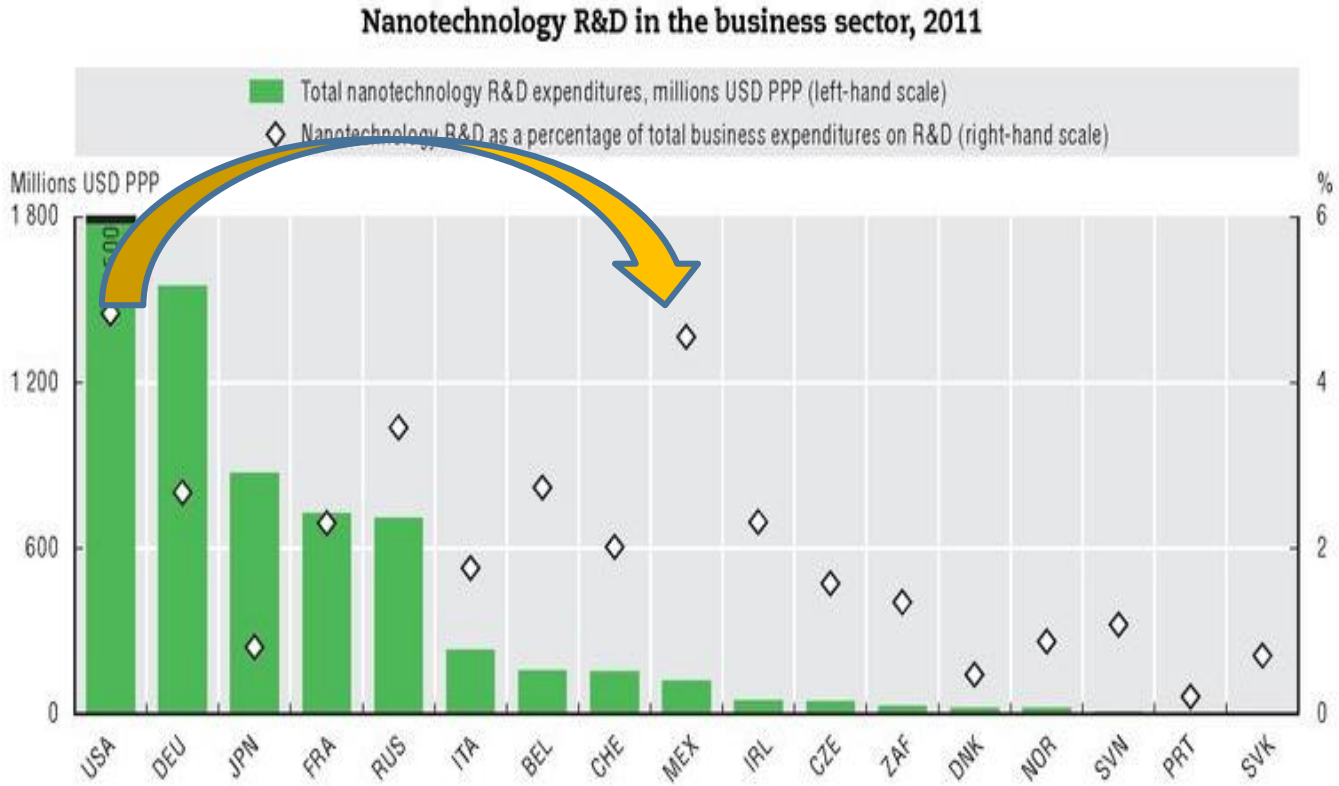
Oct. 2013

Experimental Indicator

Nanotechnology in the Business Sector (*USD PPP (left) and % of Total Business expenditure on R&D (right). OECD 2013*



Note: This is an experimental indicator. International comparability may be limited.

Source: OECD, Key Nanotechnology Indicators, http://oe.cd/kni; and OECD, Main Science and Technology Indicators Database, www.oecd.org/sti/msti.htm, June 2013. See chapter notes.

StatLink http://dx.doi.org/10.1787/888932892100

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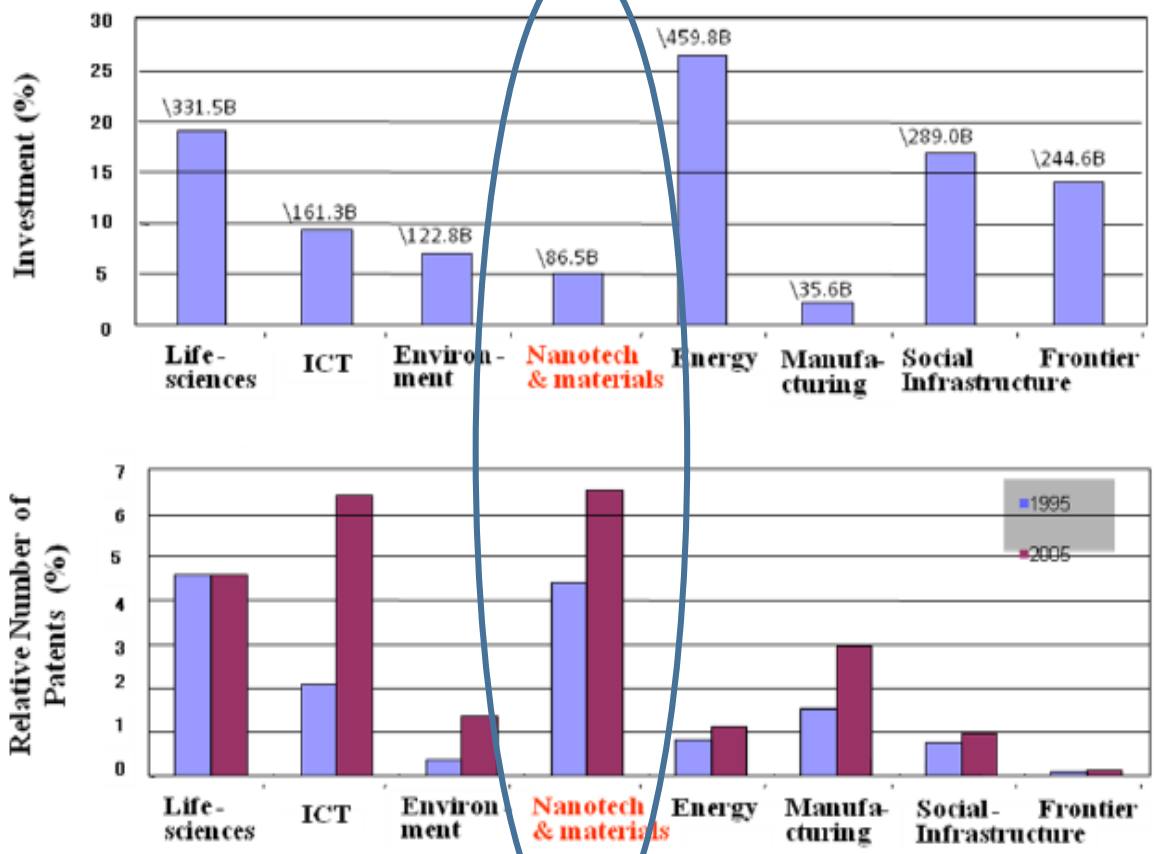
Comparing an imput and an output indicator to measure an impact: *Investment/Patents by subsets of nano-applications in* ***Japan***



Source: OECD/NNI Symposium on Assessing the Economic Impact of Nanotechnology, 27-28 March 2012, Presentation by Mr. Kaneko, Fellow, Centre for R&D Strategy, Japan Science and Technology Agency, Japan.

NanoMaterial Traceability : if and when technically feasible (radioactive and non radioactive methods) …

….then *expected by regulators and society at large*

Science
- Representation
- « metrics »

Industry
- Presence / detection
- Characterisation

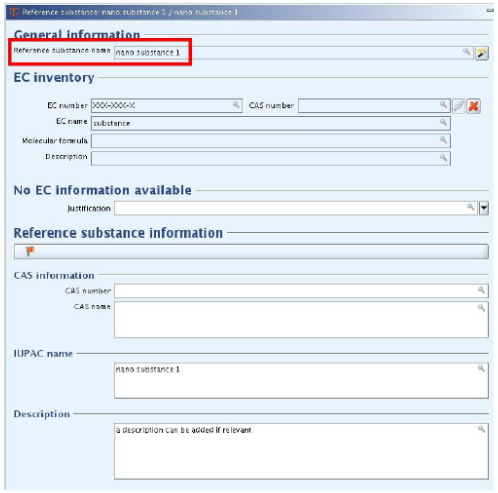
Society
- Quantity/properties and Impact
- Risk Assessment

Ontologies
- **Descriging**, Naming, Defining and
- Ontologies

Value Chain
- Producing and
- **The Value Chain** and LCA until final waste management

Legal Framework
- Governance Continuum and
- The Cascade of **Responsibilities**

Is « Free Text » appropriate and sustainable for IUCLID/REACh Nano-Substance declaration ?



Screenshot 17: Screenshot of the Reference substance created for the nanoform of the substance. Note the label (reference substance name) for the Reference substance is identical to the label of the respective composition block

For each nanoform Reference substance created for a particular composition included in section 1.2 (e.g. the reference substance for the constituent in screenshot 17 has the label "nano

ECHA EUROPEAN CHEMICALS AGENCY | OECD

IUCLID 5 is developed by the European Chemicals Agency in association with the Organisation for Economic Co-operation and Development

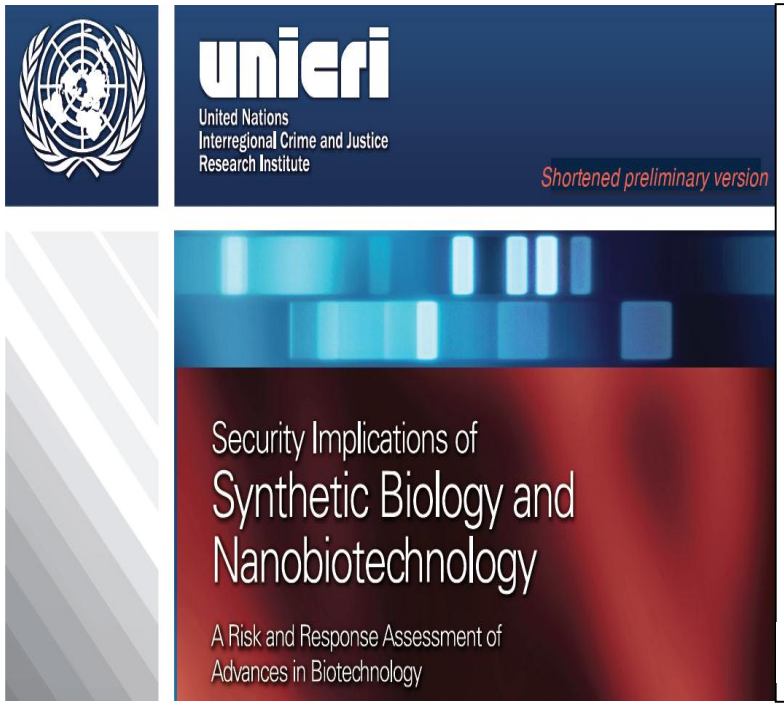
NanoMaterials in IUCLID 5

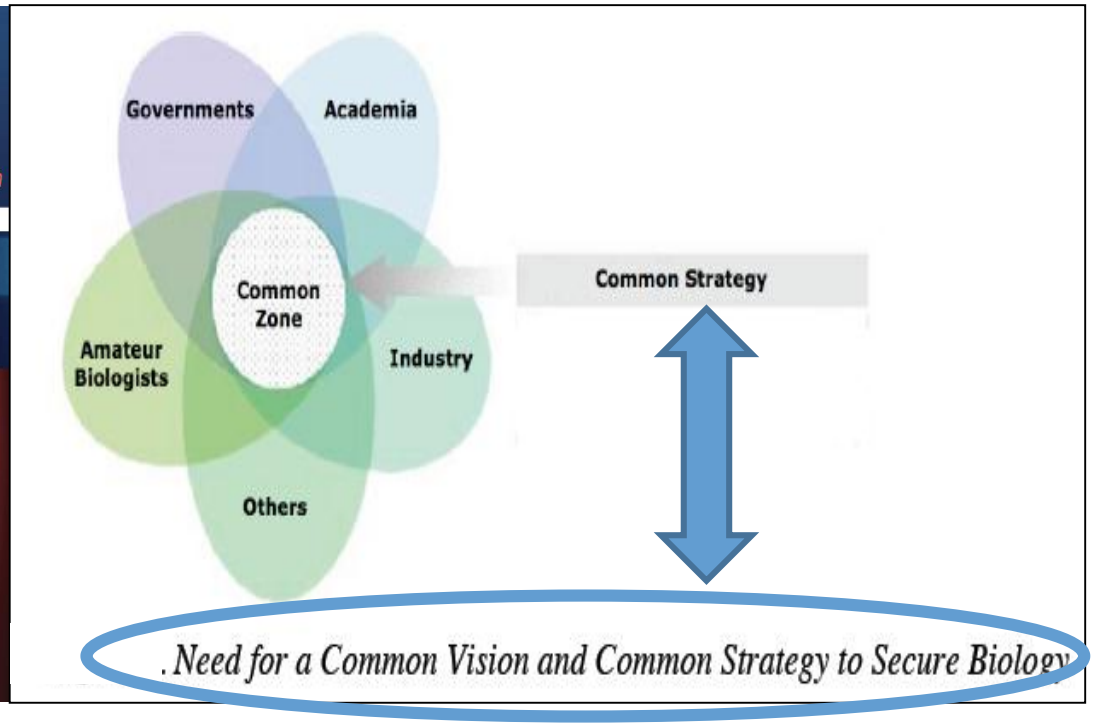
Feb. 3013, Guide for Users

- *General information/Reference substance name*: the label for the nanoform is given here "nano [substance] 1"
- *EC inventory*: the EC entry of the bulk substance may be included here (note that following this manual will not validate any decision on the substance identity made by a registrant)
- *CAS information*: the CAS number of the bulk substance may be included here if one for the nanoform is not available
- *IUPAC name*: as there is no current IUPAC name or similar international nomenclature, a descriptive commonly used name for the nanomaterial can be given
- *Description*: a description of the nanoform can be inserted here as free text
- *Synonyms*: the other names of the nanoform can be inserted here as free text

Converging Technologies at the Nanoscale raise Dual Use Research Concerns (DURC)

Addressing Risks and Responses at a Global Level





The project aimed to scan the horizon for developments in the technology fields of synthetic biology and nanobiotechnology that may – depending on their current or future ease of use and access – place potentially dangerous capabilities at the disposal of groups or individuals that are bent on causing harm to society.

Source : http://igem.org/wiki/images/e/ec/UNICRI-synNanobio-final-2-public.pdf

A Sustainability Impact Assessment (SIA) mechanism in the coming T-TIP : *An opportunity to open up global nanotechnology markets* .

Trade Sustainability Impact Assessments are a policy tool for the prior assessment of the economic, social and environmental implications of a trade negotiation. They are carried out during the underlying negotiation, and **helps integrate sustainability into trade policy.**

These assessments were first developed in 1999 for WTO negotiations.

These assessments help to integrate sustainability into trade policy: by analysing the issues covered by a trade negotiation from a sustainable development perspective,

- ***by informing negotiators*** *of the possible social, environmental and economic consequences of a trade agreement;*
- ***by providing guidelines*** *for the design of possible flanking (complementary) measures, the scope of which can extend beyond trade policy (eg, internal policy, capacity building, international regulation), and which* ***are intended to maximise the positive impacts and reduce any negative impacts of the trade negotiations in question***.

Conclusion – General Remarks
Addressing global Economic issues (public and private)

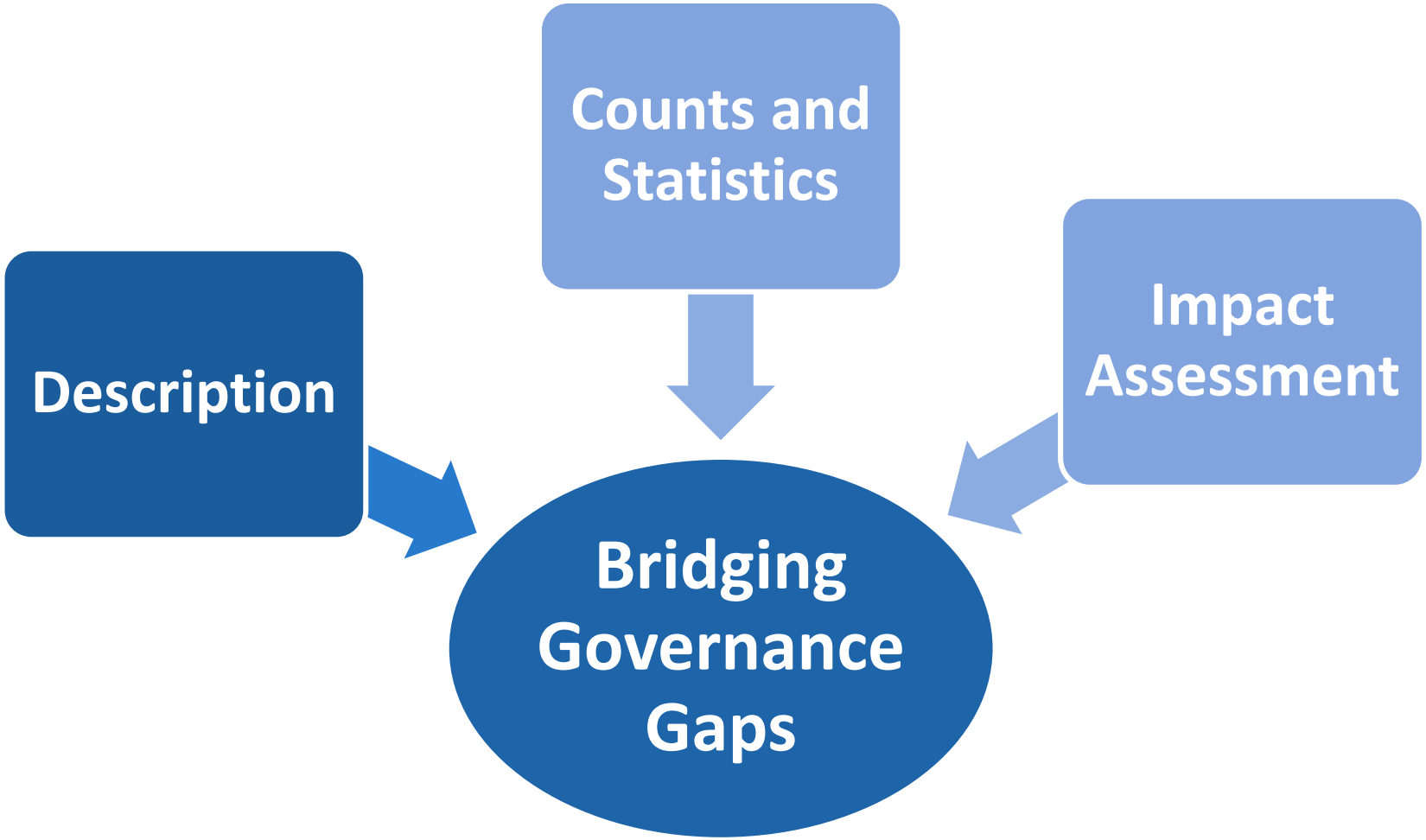
- If economic assessment may require adaptation for nanotechnology and its converging technologies future, **homogeneous economic indicators shall require extensive and long lasting international cooperation** intergovernemental and non governmental).

- **Sustainability of nanotechnology may be challenged in the future by the molecular nanotechnology, synthetic biology applications and converging technology applications**, which raises the levels of complexity and uncertainty including for economic impact assessment models.

- As regards Converging Technologies, OECD provided guidance at ministerial level in 2012 for sustainable bio-sourced products supporting the path towards Bioeconomy.

- But **a huge effort in standard setting** is required for terminology, characterization and EHS reproducible and affordable tests, inclusive of Consumers and Citizens requirements.

Nanotechnology Impact Assessment: THREE Areas for International, Intergovernmental Cooperation



➢ A Universal System of Description for nano-objects and manufactured nanomaterial: *pre-requisite*

Metrology

- **BIPM**
- **VAMAS, ICSU**

Standards

- ISO, IEC, IEEE
- Nat. Stand. Bodies

KNOWLEDGE DATABASES

Towards a

ICSU-CODATA/

OECD guidance ?

LINKING DEFINITION TO SCIENCE-BASED, STANDARDIZED DESCRIPTIONS

An International Initiative towards a Unified System to Describe Nano-Objects/Nanomaterials

ICSU/CODATA and OECD WPN initiative:

- Paris Workshop 23-24 Feb. 2012

« An international, pre-standardization project is needed to develop multi-disciplinary, multi-use requirements of the data necessary to describe materials at the nanoscale » **Open access, open source, well curated meta database. »**

- Next Step 2013 :

Since the workshop, a joint CODATA/VAMAS (Versailles Project on Advanced Materials and Standards) working group has been established with the objective of developing a pre-normative White Paper setting out the requirements for a description system for materials at the nanoscale. and multi-lingual basis.

http://www.codata.org/highlights/Highlights2012.pdf

Expected Impacts : ***Metrology, Scale-Up, Innovation, Quality, Traceability, IP revenues, Fair International Trade, Security, Safety*** **to increase** ***Investors, Citizens and Consumers trust; Convergence of Regulatory Frameworks***

Conclusion –

Two Priorities for Action at International Level

In the short run, two actions are proposed:

- **Engaging an international cooperation aiming at a universal system of description/descriptors at the nanoscale**, well curated and its corresponding meta-database available (accessible): a prerequisite for improving any kind of assessments (technology, safety, security, EHS, economic, industrial, commercial, IPR, regulatory). Cf. On going ICSU-VAMAS White Paper.

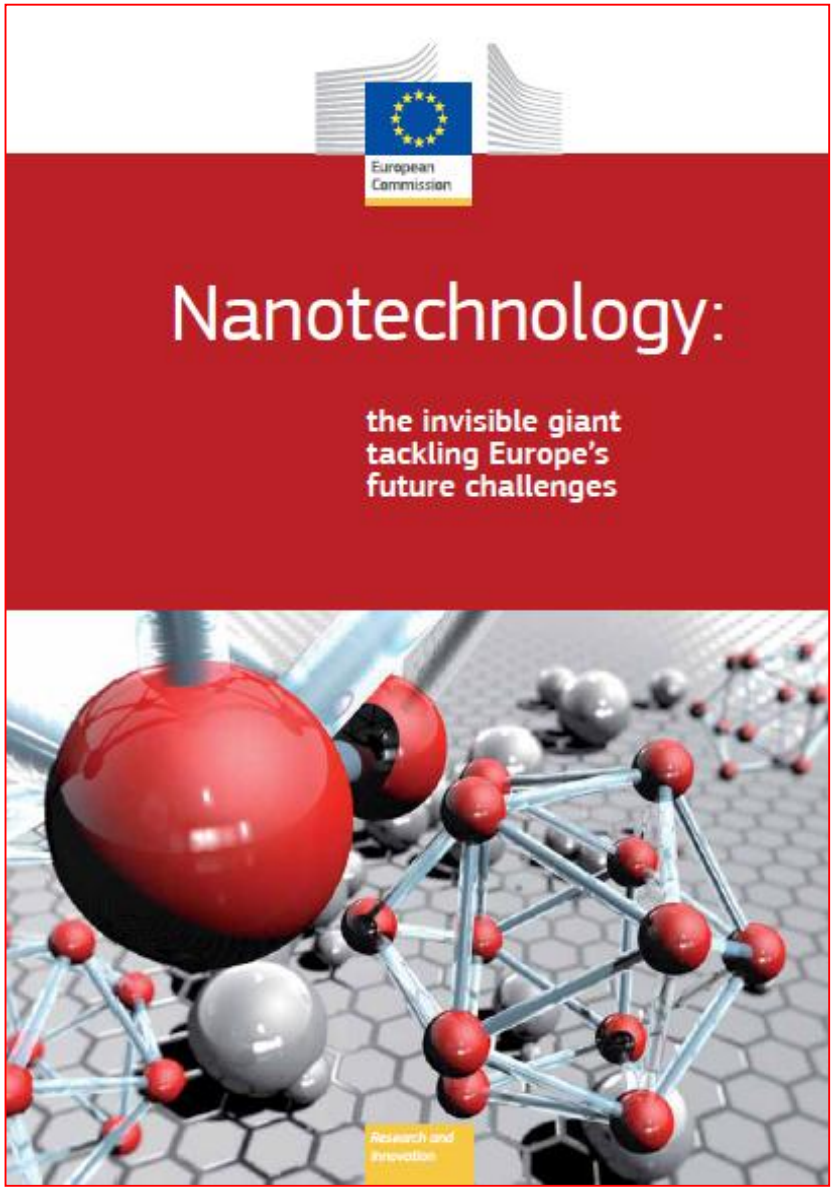
- An opportunity from 2013 to 2015 to **go beyond the "precautionary principle" traditional commercial disputes: the SIA (**Sustainable Impact Assessment**) T-TIP *mechanism*, which could be "powered" by the "RRII" concept "*engine*" , then disseminated at a global scale**. Economic impact : lowering non tariffs, technical barriers to trade(TBT), lowering cost production and avoiding dumpings of any sort (economic, environmental and societal). Cf. CETA/ Canada-EU Trade Agreement SIA available report.

❖ **SNO Members Initiatives are most welcomed at OECD Level via US Delegation to OECD and BIAC (OECD Industrial Advisors)**

A European Perspective to

Nanotechnology: The Invisible GIANT

Tackling Europe's Futur Challenges



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BETTER POLICIES FOR BETTER LIVES

Assessing the Economic Impact of Nanotechnology: an OECD Perspective

Thank You for Your Attention

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Dr. Françoise ROURE
Chair, Committee « Technologies and Society »
French High Council of Economy

SNO Conference

Santa Barbara (CA), *4 November 2013*